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PROGRESS IN PEDIATRIC NUTRITION

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PROGRESS IN PEDIATRIC NUTRITION
II. The Mineral and Vitamin Requirements in Premature Infants

By RUTH WOODS

The tremendous reduction in infant mortality as a result of prematurity is one of the most heart-warming achievements of medical science within the past decade. Many factors are involved in this dramatic success story, beginning with prenatal care during pregnancy and extending into the numerous phases of post-natal handling of the infant. Advances in physical techniques and equipment, highly specialized nursing care, and the adaptation of modern nutrition principles to the requirements of the expectant mother and to the unique needs of the immature infant are among the most significant of these factors. This Review is concerned with the last of these, namely: the nutritional requirements of the young infant, immature in terms of physiological or chronological development, or both. The special energy and protein requirements of the premature baby have been outlined in a previous Review*; the vitamin and mineral requirements are described below.

The Problems of Immaturity:

For purposes of clarity it may be helpful to repeat here briefly the facts concerning the nature of prematurity or immaturity and the reasons for the need for specialized nutrition in such cases. As already pointed out, prematurity may be *chronological* (any infant born before the 36th week of gestation) or *physiological* (any *full-term* infant weighing less than 2500 grams [5½ pounds] at birth or having a body length less than 18 inches at birth). In both types, the organism is below the anatomic and physiologic standards for mature infants and begins life with numerous physiological handicaps. Respiration, temperature control, sucking and swallowing reflexes, digestive ability, liver and kidney functions, enzyme systems, body stores of essential nutrients are all incompletely developed in the immature organism. These deficiencies must be compensated for by special feeding techniques as well as by special attention to heightened nutritional requirements.

In summary, the premature infant has a multiple problem:

(1) Overcoming nutritional deficiencies caused by inability to cope efficiently with foods,

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*cf. *Borden's Review of Nutrition Research,* June, 1950, "Progress in Pediatric Nutrition. I. Energy and Protein Requirements in the Premature Infant."

(2) Overcoming actual loss of nutrients as a result of predisposition to hemorrhage,

(3) Overcoming nutritional deficiencies caused by the exceptionally heightened requirements resulting from a poor start (deficient nutrient storage during gestation) and from the demands of stress factors (rapid growth; predisposition to infection).

Calcium, Phosphorus and Vitamin D:

These three nutrients are so closely related in the body metabolism that requirements for them can be described only in terms of their mutual interdependence rather than individually.

The major function of calcium, phosphorus and vitamin D is, of course, the synthesis of new material for bones and teeth. In the newborn infant, particularly in the immature individual, this is one of the most rapidly advancing processes.

A major circumstance determining the calcium and phosphorus needs of premature infants is the fact that premature birth has deprived them of placental nutrition during a period in which they normally would have acquired the major portion of their stores of these essentials (1, 2, 3). Most of these stores are acquired during the last three months of pregnancy; in fact, it has been shown (3) that three times as much calcium is deposited in the fetus in the last two prenatal months as is deposited in the entire first seven prenatal months. This deficiency is often manifested during the very process of birth itself. Premature babies have skulls which are less well calcified than those of full-term babies and which, therefore, are highly susceptible to injury with a greater risk of intracranial hemorrhage.

Importance of Prenatal Calcium Storage: Studies with full-term infants have shown that the reserve stores of calcium acquired during prenatal life are extremely essential in contributing to adequate calcium nutrition during the first three months of life (4). For example, analyses of the calcium content of full-term infants by Hamilton (5) indicated a wide range of values, with an average value of about 8 grams of calcium per kilo of body weight. Using this figure as a guide, some estimation has been made (6) as to the amount of calcium that an infant of average weight would have to absorb daily in order to maintain the calcium content of the skeleton at the same level as at birth (full-term).

Whether infants can obtain these amounts of calcium (Table 1) has been determined by an analysis of existing data on the calcium values of human milk, and on the degree of absorption of dietary calcium exhibited by average, full-term, breast-fed infants. In this analysis (Table 2) three

TABLE 1. Daily Calcium Requirements of an Infant at Varying Ages Necessary to Maintain the Same Calcium Concentration as at Birth (4)

Age in Weeks	Infants' Weight	Total Amount of Calcium in Body at 8.127 gms. per Kilo	Daily Requirement of Calcium During the Month Necessary to Maintain Calcium Level at Birth
	grams	grams	grams
Birth	3688	29.97	——
4	4195	34.09	0.147
8	4939	40.07	0.214
12	5613	45.6	0.200
16	6208	50.4	0.172
20	6775	55.0	0.164
24	7314	59.4	0.157

average levels of absorption are used (high 60%; medium 45%; low 30%) and three average levels of calcium content of breast milk have been used (high, 36 mg. per 100 ml.; average, 30; and low, 22 mg. per 100 ml.)

The italicized figures indicate those instances in which absorption actually reached the daily requirements. From these figures it is apparent that only a very small percentage of babies are able to obtain sufficient calcium during the first three or four months to maintain the degree of calcification equal to that at birth. If this is true of full-term infants with presumably adequate stores of calcium, it can readily be appreciated how much greater must be the calcium need of the premature baby with little or no calcium reserves from prenatal life.

It has been generally believed, up until very recently, that infants, both full-term and premature, retain more calcium from breast milk than they do from cow's milk. At the time this concept was still generally accepted, however, Stearns (7) discovered that infants fed on full-strength cow's milk actually have more calcium in their bodies between 8 and 40 weeks than do breast-fed babies. This was thought to be due to the much higher calcium content of cow's milk. This somewhat paradoxical finding was later confirmed and more thoroughly explained by Benjamin *et al* (8).

Calcium-Phosphorus Studies with Premature Infants: In actual calcium and phosphorus retention studies with premature babies, Benjamin, Gordon and Marples (8) reported several important findings. Premature infants were found to retain a greater portion of the calcium and phosphorus intake than do normal full-term infants. Both types of infants, however, show

retentions which increase with a corresponding increase in dietary supply. They found, further, that premature babies utilized the calcium of cow's milk to a greater degree than that of human milk. The average percentages retained were 71% from cow's milk and 45% from human milk. This was believed to be because of the adequate calcium: phosphorus ratio of cow's milk as opposed to human milk which is low in phosphorus.* The apparent discrepancy between this finding and numerous earlier reports in the literature (5, 9, 10), is attributed by the authors to the fact that their subjects, unlike those of the earlier workers, were given supplements of vitamin D which is necessary for proper utilization and retention of calcium and phosphorus.

Like calcium, retention of phosphorus showed a direct relationship to dietary supply. More phosphorus, however, was retained from human milk than from cow's milk, the average percentages being 87 and 61, respectively.

The higher intake of magnesium in the cow's milk preparation (39 mg. per kilo as compared with 12 mg. per kilo in human milk) resulted in higher magnesium retentions, the retentions being 33 mg. for cow's milk as compared to 5 mg. for human milk.

Estimation of Calcium-Phosphorus Requirements of Premature Infants: Benjamin *et al* calculated the calcium requirement for premature infants on theoretic grounds, using three sets of standards:

1. *The minimal accepted level:* The lowest degree of calcification reported for a young, supposedly non-rachitic full-term infant receiving human milk.
2. *A more desirable level:* An amount of dietary calcium which would permit the premature infant to begin from birth to correct systematically his initial deficit and to attain by the end of the first year the degree of calcification shown by a full-term infant.
3. *The highest possible level:* An amount of dietary calcium which would permit calcification to proceed at a rate comparable to that which would have occurred had the infant remained *in utero* to term.

Using these standards, they demonstrated that mineral retention on a diet of human milk supplemented with vitamin D was inadequate to meet

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*As pointed out by the authors, in rapidly growing infants the proportion of retained calcium to phosphorus is between 1.5:1 and 2:1. Since the human milk in their study had a Ca:P ratio of 2.1 and the cow's milk a ratio of 1.5, proper retention ratios could have resulted only from retention of similar percentages of both minerals. This occurred with cow's milk, the average percentages being 71 and 61, and the Ca:P ratio, 1.8. With human milk, however, large retentions of phosphorus (87%) were accompanied by much lower calcium retentions (45%), giving low Ca:P ratios, ranging from 0.7 to 1.2. Such a low ratio is indicative of relatively poor calcification (11). Even if 100% of the phosphorus of human milk were retained and utilized for bone formation, the calcium retention would then be only 53%, a ratio of only 1.1. Thus, human milk may be considered too low in phosphorus (part of which, furthermore, is preferentially used for synthesis of protoplasm and thus not available for bone formation). This low phosphorus content, as well as the low calcium content, are believed to be the limiting factors in calcium retention from human milk.

even the lowest calculated requirement. Retentions by the premature infants with the cow's milk diet, on the other hand, were sufficient to insure normal calcification of the bones by one year of age.

Since the retention of phosphorus showed the expected relationship to retention of calcium and nitrogen, the conclusions concerning the calcium requirement were considered equally applicable to the phosphorus requirement.

TABLE 2. Calcium Absorptions at Different Levels of Calcium Content of Human Milk at Various Ages

Age of Infant	Average Daily Milk Intake	Percentage Absorption of Calcium from Intestinal Tract	CALCIUM ABSORPTION			Avg. Daily Calcium Requirements Necessary to Maintain Calcium Concentration in Body as at Birth (From Table 1)
			Low Calcium Content of Milk: 22 mg./100 ml.	Medium Calcium Content of Milk: 30 mg./100 ml.	High Calcium Content of Milk: 36 mg./100 ml.	
	cc.					mg.
At end of 4th week	770	30	51	69	83	147
		45	76	104	125	
		60	102	140	***167***	
At end of 8th week	900	30	59	82	97	214
		45	89	122	146	
		60	119	162	192	
At end of 12th week	1000	30	66	90	108	200
		45	99	135	162	
		60	132	180	***216***	
At end of 16th week	1070	30	70	93	116	172
		45	106	140	***173***	
		60	141	***187***	***230***	
At end of 20th week	1130	30	74	102	122	164
		45	112	150	***184***	
		60	150	***200***	***245***	
At end of 24th week	1200	30	79	108	130	157
		45	119	***162***	***195***	
		60	***158***	***216***	***260***	

Supplements of both calcium and phosphorus, therefore, should be given to breast-fed premature infants and, possibly for maximum benefits, even to artificially-fed infants. These may be given in the form of calcium paracaseinate or as syrup of calcium lactophosphate. Crosse (12) suggests a daily dosage of 7 minims per pound of the latter, equivalent to 32 mg. of calcium lactate per pound, beginning on the fourteenth day of life.

Vitamin D: For proper utilization of dietary calcium and phosphorus and, thereby, to forestall the development of rickets, adequate supplementation of the diet with vitamin D is essential. Premature infants are more than usually susceptible to rickets for the following reasons:

1. They have a deficient store of calcium, phosphorus and vitamin D at birth.
2. Only a relatively small part of the skeleton is calcified at birth.
3. Although absorption of calcium and phosphorus is normal, fat absorption — and consequently vitamin D absorption — is faulty.
4. Growth rate is rapid, increasing demands for calcium, phosphorus and vitamin D.
5. They are less exposed to natural sunlight (source of vitamin D) because of their small size and frailty.
6. They are very susceptible to infection and digestive upsets which further interfere with fat and mineral absorption.

Daily Requirement: Normal infants require about 400-500 I.U. of vitamin D per day, although some authorities suggest at least 800-1000 I. U. (13). For prematures, the requirement is considerably higher, ranging from 5,000-10,000 I.U. per day (13), with a generally accepted figure of 5,000 I.U. (12). In some cases, it has been found that even a dose of 5,000 I.U. per day may be inadequate for complete protection (14).

It is important to note that massive doses of vitamin D, such as may be used in cases of refractory rickets in older children, may be exceedingly dangerous and even fatal. Dosages of the order of 25,000 to as much as 1,000,000 I.U. of vitamin D per day have been used for the treatment of refractory rickets or hypoparathyroidism, but unless careful checks are made every few days, symptoms of toxicity may develop with doses of this magnitude. The harmful effects include toxicity (pallor, weakness and loss of appetite) as well as extensive calcification of the soft tissues including those of the kidney, with resulting permanent renal damage. The average dosage of 5,000 I.U. per day for the premature baby would seem to be well below the range of these potentially dangerous higher dosages.

In addition to vitamin D, calcium and phosphorus supplements, Crosse (12) suggests that infants over 4½ lbs. who are strong enough to be handled be carefully exposed to ultra-violet irradiation two or three times weekly; older and stronger premature babies should be exposed to natural sunlight as soon as they can be taken out of doors.

Vitamin D is given in small amounts after one week of age and gradually increased to 5,000 I.U. daily by three weeks. This level is maintained until the baby reaches a weight of 8 lbs. at which time, the dose may be reduced to 1,500 I.U. daily (12).

Iron:

The normal, full-term infant does not require a dietary supplement of iron until several months after birth, having stored sufficient for his needs during prenatal existence (assuming an adequate nutritional status of the mother). About 15-20% of this is stored in the liver; the major portion is in the red blood cells (15).

In contrast to the full-term infant, the premature infant has been able to store very little iron prior to birth. Furthermore, the blood-forming centers are very immature. As a result, there are fewer red blood cells (erythrocytes), larger numbers of incompletely developed blood cells (reticulocytes, etc.), and greater destruction of these more fragile types of cells. In addition to these handicaps, the demands of rapid growth; blood dilution due to increased volume without accompanying increase in red cells; and the susceptibility to infection contribute further to the almost certain development of anemia.

Anemia: There are two types of anemia which develop in the premature baby; one during the first three months of life and the second, subsequent to this. The early anemia is due largely to the small numbers of erythrocytes and to the increased destruction of the fragile reticulocytes and normoblasts. This anemia does not respond to iron therapy (16), but, if severe, can be treated only by transfusion. Administration of iron after the 4–6th week of life, however, may be of some value in that it makes iron stores available for a later period when the child becomes able to convert iron into hemoglobin. This may limit the duration of the early anemia and prevent the development of the later type of anemia.

The later anemia is directly influenced by iron deficiency. It is characterized by a hemoglobin level which fails to keep pace with the growing red cell count. This anemia responds well to iron therapy. Satisfactory hemoglobin levels have been established in infants 9–10 months of age on daily doses of 10 mg. of iron (4). The iron is usually started in small doses, well diluted with the feed, in order to avoid the gastrointestinal upsets which often accompany the use of iron in small infants. The addition to the diet of iron-enriched cereals, milk preparations, egg yolk, strained meats (particularly liver), fruits and vegetables as soon as feasible after the third month contribute in large part toward the prevention and treatment of this type of anemia.

Vitamin A:

The premature infant is deficient in vitamin A as it is in other nutrients because of insufficient prenatal storage. The vitamin is stored in the liver.

Not only is the concentration of vitamin per gram of liver lower than normal, but the actual size of the liver is smaller than in full-term infants, thus constituting a double handicap (17). In addition, fat absorption is poor. Consequently the absorption of the fat-soluble vitamins (A, D, E and K) is likewise impaired. The recent development of a water-soluble form of vitamin A in a carrier of ethylene glycol has provided a more readily absorbable source of this vitamin.

Absorption and Utilization Studies: About six years ago, Henley, Dann and Golden (17) conducted a series of comparative studies on premature and full-term infants in order to determine the degree to which absorption, storage and requirement of vitamin A are influenced by prematurity. Their studies were designed to determine three things:

1. Response to test doses of Vitamin A as evidenced by changes in blood plasma levels of the vitamin, correlated with studies on fat excretion.
2. Determination of average plasma levels of vitamin A ordinarily occurring in premature babies several weeks of age and correlation of findings with birth weight and vitamin intake.
3. Determination and comparison of vitamin A storage levels in the livers of premature and full-term infants.

Their results indicated that premature infants generally, but not always, absorb vitamin A poorly and that, in both premature and full-term infants, increased age is associated with increased efficiency of absorption. Poor fat absorption, whether in premature or full-term babies, was reflected in poor retention of vitamin A. The tendency to poor fat absorption was greater in prematurity. Nevertheless, estimation of vitamin A blood levels of 3 week old premature babies indicated values of the same order as those reported by many investigators for full-term infants. The blood levels of vitamin A were apparently not influenced by birth weight, but showed direct correlation with dietary intake. On the other hand, marked differences were found in the reserve liver stores of vitamin A, full-term babies having more than twice the percentage of vitamin A stores than did the premature babies. The amount in the entire liver was more than five times as great in the mature babies as it was in the prematures.

Although in no instance was clinical evidence of vitamin A deficiency in the premature group apparent, the low reserves, low plasma levels (in infants on unsupplemented diets) and poor absorption of fat and vitamin A, strongly suggest the possibility of existing sub-clinical deficiency or of easily developing frank deficiency. These authors therefore recommend early supplementation of premature infants' diets with vitamin A as a desirable routine procedure.

Two years ago, a further investigation of the problem of vitamin A absorption by prematures was conducted by Clifford and Weller (18). The need for vitamin A, already indicated by the work of Henley *et al* (17), had been further emphasized by the opinions of Lewis and associates (19) who suggested that low plasma levels of the vitamin indicate actual vitamin deficiency. Also, Lund and Kimble (20) had demonstrated that little or no vitamin A is transmitted from mother to fetus and, therefore, suggested routine dietary supplementation with vitamin A for all newborn infants. The studies of Clifford and Weller were designed to establish the most effective means of administering vitamin A to the premature infant. Forty-two infants were given vitamin A in oil by mouth; forty-one were given water-miscible vitamin A in alcohol or propylene glycol by mouth.

In contrast to the findings of Henley's group, (consisting of only 10 babies, 40% of whom had poor vitamin A absorption), 90% of the babies studied by Clifford and Weller (42 cases) had poor absorption of vitamin A in oil. Of those infants who received water-soluble vitamin A, however, 90% showed *good absorption* despite the handicap of prematurity. Retention and liver storage of water-soluble vitamin A was likewise reported greater in the earlier studies by Lewis *et al* (19) on normal infants and children.

These findings would seem to indicate the desirability not only of providing vitamin A supplements for premature babies, but also, the obvious advantage of providing this vitamin (and possibly also vitamin D) in the more readily absorbable water-soluble form. The actual amount of vitamin A required daily varies with medical authorities, the values ranging from a conservative 5,000–6,000 I.U., to very large doses of the order of 20,000–25,000 I.U. (4).

High Fat Diets and Vitamin A Absorption: In marked contrast to the beliefs of most pediatricians, Holt and associates (21) presented evidence just a few months ago indicating the possible desirability of feeding high fat diets to premature babies. Although their investigations confirmed the fact that such babies do not absorb and retain fat well, they found that increasing the fat content of the diet had no influence on the *percentage* of fat absorbed. The percentage absorption remained similar whether the diet was high or low in fat; but the total or net amount of fat absorbed and retained was correspondingly greater when more fat was supplied. Vitamin A absorption was approximately the same on both high and low fat intakes.*

*The use of an oily preparation of vitamin A, *homogenized* in the milk, was believed to be an important factor in the absorbability of the vitamin (about 65-66%) as compared to a slightly lower absorption (62%) in full-term infants fed the vitamin A oil separately in unemulsified form.

†There were eight babies in the present study.

No digestive disturbances were noted. The possibility of increasing calories without bulk by extra fat (an important consideration in the dietary management of prematures) was indicated, although further studies with larger groups of babies† are indicated before this new procedure can be advocated as routine practice.

Vitamin C:

Vitamin C is required by all new-born infants soon after birth, the need being determined largely by the condition of the prenatal stores and the amount present in the milk. The vitamin C content of breast milk is extremely variable and reflects the adequacy or inadequacy of the mother's diet during lactation. Although cow's milk may initially provide satisfactory amounts of ascorbic acid, there is considerable loss of this vitamin through pasteurization and subsequent heat-treatment (often boiling) of infants' formulas.

The premature baby has relatively low stores of ascorbic acid and receives virtually none in an unsupplemented diet. The baby is customarily fed boiled cow's milk formulas or, since it is usually too weak to be nursed directly, pooled mixtures of pasteurized or boiled mother's milk. Both of these milks are almost entirely devoid of ascorbic acid. In addition, it has recently been demonstrated (22) that the premature baby has a special need for adequate supplies of ascorbic acid in order to permit the complete metabolism of the aromatic amino acids, tyrosine and phenylalanine.*

Vitamin C and Aromatic Amino Acid Metabolism: This subject has been thoroughly reviewed in a previous issue* and will be repeated here only briefly for the purpose of completing the discussion in the present context.

When premature infants are fed high protein diets, particularly as made possible by the use of cow's milk mixtures, several abnormal metabolites are excreted in the urine. These have been identified as products of the incomplete metabolism of the amino acids, phenylalanine and tyrosine. Full-term infants do not ordinarily exhibit this defect, but it can be precipitated by the feeding of a single large dose of either amino acid. The condition responds dramatically to dietary supplementation with vitamin C (100–500 mg. doses) and can be prevented by the inclusion of adequate amounts of the vitamin in the daily diet. It was further shown that the use of high protein diets for prematures not only results in the defective metabolism of these amino acids, but also causes a quicker desaturation of the vitamin C

**cf. Borden's Review of Nutrition Research*, September, 1949, "Dietary Interrelationships—Vitamin C and the Metabolism of Aromatic Amino Acids."

content of the tissues (23) thereby predisposing to scurvy unless additional ascorbic acid is provided.

Vitamin C and Anemia: Vitamin C has long been known to be of value in the therapy of certain types of anemia, in addition, of course, to the use of other therapeutic agents including iron, protein, folic acid, vitamin B_{12} and the like. That vitamin C permits more efficient utilization of protein has already been shown in the special case described above. Other studies show an important interrelation between vitamin C and folic acid, in which the defective amino acid metabolism caused by ascorbic acid deficiency has been found to be corrected by folic acid as well (24).* A similar interplay has been reported between faulty tyrosine metabolism and its correction by antipernicious anemia extracts (25) in place of vitamin C.* The intestinal absorption of iron has been shown to be markedly enhanced by vitamin C (26). Vitamin C deficiency has been implicated in the development of folic acid deficiency or in an interference with folic acid metabolism in that certain types of megaloblastic anemia of infancy have been found to respond to either vitamin C or folic acid (27) or to develop as a result of vitamin C deficiency. Vitamin B_{12} alone, unlike folic acid, had no curative effects, but was effective when administered together with vitamin C.

These facts would suggest an added need for vitamin C in the premature infant who is especially prone to develop anemia.

Vitamin K:

Vitamin K is essential for the proper clotting of the blood.** The vitamin makes possible the synthesis of one of the important clotting factors, *prothrombin.* In the new-born infant there exists a so-called physiological hypoprothrombinemia which is characterized by a drop in blood prothrombin which reaches a maximum from 48 to 72 hours after birth. This drop is greater in premature infants and occurs sooner (28, 29, 30). In the full-term infant, the levels are gradually restored to normal by the end of the first week. Because of the great susceptibility of premature babies to spontaneous hemorrhage and also because of the greater possibility of intracranial hemorrhage occurring during birth from pressure on the inadequately calcified skull bones, it is vital that this physiological hypoprothrombinemia be prevented or quickly corrected. This may be done by giving vitamin K to the premature infant orally or by injection within an hour of birth or as soon thereafter as possible. The dosages range from 0.5–1 mg. to 2 mg. (31, 32).

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*cf. *Borden's Review of Nutrition Research*, September, 1949, "Dietary Interrelationships—Vitamin C and the Metabolism of Aromatic Amino Acids."

**cf. *Borden's Review of Nutrition Research*, April, 1943, "The Story of Vitamin K."

Other Nutritional Considerations:

B Complex: There is little evidence to indicate a specialized need for members of the vitamin B complex above levels which are present in the ordinary diet of premature babies. It is, however, generally recommended that a suitable B complex supplement be added as a routine measure for dietary improvement as is often done in the case of normal, full-term infants as well.

Retrolental Fibroplasia: Retrolental fibroplasia is an eye condition leading to permanent blindness which may sometimes occur in premature babies, particularly in those under 4½ lbs. It is a condition which is thought to develop soon after birth, rather than being of congenital origin. Many factors, some nutritional, have at one time or another been implicated. Among the nutritional factors thought to be involved have been vitamin A, iron and vitamin E. At the present time, there is no conclusive evidence of any kind as to the origin, prevention or cure of the condition, although much work of an experimental nature is being conducted. Should the nutritional factors eventually be found to play a part in the cause or cure of retrolental fibroplasia, this subject will be discussed in full in a future issue.

Conclusion:

Modern medical science, nutrition research and highly skilled nursing techniques have been combined to bring the precious gift of life to the countless numbers of tiny babies born before they are fully equipped to cope with the physical and physiological problems of living. In all three of these fields, progress is still being made toward achieving a degree of success even greater than the gratifying high percentage which already exists. Application of the principle of modern nutrition is not only a major factor in protecting the life of the prematurely born, but is perhaps the greatest single factor in insuring a sound and normal future development for such infants. The goal of nutrition in pediatrics may be described in the familiar phrase borrowed from the closely allied science of geriatrics: "Not merely to add years to life, but to add life to the years."

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NEWS DIGEST

ACTH AND DIET THERAPY: Within recent months dietitians have increased their services to include the planning of special diets for patients being treated with the adrenocorticotropic hormone (ACTH). Preliminary observations seem to indicate that these patients have enormous appetites. There is as yet very little data available as to the special dietary requirements associated with ACTH therapy, although some guide to these may be inferred from a consideration of the known physiologic effects of the hormone. These include alterations in glucose metabolism; interference with the metabolic cycle involving acetylcholine (significant in transmission of nerve impulses); water retention; disturbances in potassium balance; alkalosis and possibly, hypertension. Because of these powerful side reactions which may accompany the therapeutic effects of ACTH, long-range diet planning becomes a very important phase of clinical management when this hormone is to be used in chronic diseases. —*J. Am. Diet. Assoc.* 26, 672 (1950).

SYNTHETIC EGG WHITE FROM CODFISH: A process has recently been developed for converting cod fish waste into synthetic egg white. Production is carried out by a completely chemical and mechanical process. One pound of the new synthetic is said to be equivalent to the egg white contained in 150 hen's eggs. This amount of synthetic albumen is made from 11 lbs. of cod fish waste. The process at present produces more than 600 lbs. of synthetic "albumen" daily, an amount roughly equivalent to the output of 100,000 hens. The synthetic "albumen" consists of 80 to 90 per cent protein and is adaptable for use in baking, ice cream, mayonnaise and pharmaceutical products, as well as for industrial products.—*Chem. Eng. News.* (1950)

LYSINE IN BREAD: The addition of synthetic lysine to bread has been shown to stimulate greater growth gains in experimental animals than are customarily obtained in such animals fed the same bread without lysine. Wheat protein is known to be relatively low in lysine and, as a result of milling, the proteins in wheat flour are even more deficient in this amino acid. A diet providing adequate amounts of meat, milk, cereals, eggs and bread contains all the lysine essential for proper nutrition. Nevertheless, the promising growth results with rats suggest that bread fortified with lysine might be considered if it should ever become necessary to improve human nutrition by an increased intake of this essential amino acid. — Abstr. talk given at 118th Am. Chem. Soc. Meeting, Sept. (1950)

NUTRITION SURVEY, N. Y. STATE: A survey of the nutritional status of a small township in New York State has recently been completed. The survey results report food usage in terms of nutrients available for more than 200 farm, rural non-farm and village families and for 805 individuals in the fall season of the year. Similar information is reported for 175 families in the spring. On the basis of family food records, making no allowance for waste or cooking losses, the average picture was one of adequacy in relation to the Recommended Dietary Allowances for every nutrient except calcium. The village families had the least favorable intakes, followed by the rural non-farm group, with the farm families having the most abundant supply of nutrients available. Individual families were markedly below the allowances for several nutrients. There were no esential differences in average nutrients available per nutrition unit in the fall and in the spring, except in the case of vitamin A.

For every residential group the vitamin A available in the spring was substantially under that available in the fall, but still exceeded the allowance.

Single day records for individual family members showed the female members of the family to occupy a relatively less favorable position as compared to the male members in regard to the intake of most nutrients. It would appear that the young children had the best food records; next came the rest of the male members of the family. The two groups which fared most poorly were the women of child-bearing age and the adolescent girls. Adequate family averages covered up less adequate intakes of individual family members. A sizeable percentage of individuals failed to meet the allowances with a smaller percentage who had rather marked deficiencies in intake—*J. Am. Diet. Assoc. 26,* 776 (1950)

PYRIDOXINE IN AMINO ACID METABOLISM OF POULTRY: Studies have been made on the effects of high levels of individual amino acids on chicks fed pyridoxine-low diets and diets containing adequate amounts of pyridoxine. The growth was depressed by the addition of certain amino acids to a low-pyridoxine diet, whereas if sufficient pyridoxine was present, growth was increased by the addition of the amino acid. Addition of methionine, cystine, lysine, phenylalanine, valine, isoleucine, histidine or tryptophane depressed growth on both diets. This growth depressing action was somewhat similar to that previously reported on niacin-low diets. Addition of four percent of different amino acids to the diet increased the levels of non-protein nitrogen and amino nitrogen in the blood.

The addition of glycine to a diet containing 18 percent casein and 5 percent gelatin resulted in increased growth. However, when glycine was added to a similar diet containing 24 percent casein and 4.5 percent gelatin no growth increase resulted. This would indicate that the growth response obtained from the addition of glycine to the former diet was not due to a specific need for glycine.—*Poultry Science 28,* 755 (1949)

VITAMIN B_{12} IN COW'S MILK: Studies have been made comparing the inferior growth observed in rats fed goat's milk mineralized with iron, copper and manganese with the good growth of rats fed cow's milk similarly fortified with minerals. The poor growth on goat's milk was counteracted by a daily addition of 50 mcgm. of folic acid plus 0.1 mcgm. of vitamin B_{12}; or 0.5 mcgm. of vitamin B_{12} alone; or 1.0 gm. of fresh beef liver. Goat's milk was found to contain only traces of vitamin B_{12} in contrast to the occurrence of 2-3 mcgm. of vitamin B_{12} per liter in cow's milk. The folic acid content of goat's milk was found to be very low and comparable to cow's milk. Folic acid or vitamin B_{12} additions to mineralized cow's milk did not further increase growth in the young rat. The addition of vitamin C to the cow's milk diets produced a large increase in the vitamin B_{12} content of the livers. On the goat's milk diets, added vitamin C had no effect. Folic acid and vitamin B_{12} additions to mineralized cow's milk or goat's milk did not affect the rate of hemoglobin formation in the weanling rat or in rats made anemic on milk diets. —*Fed. Proc. 9,* 355 (1950)